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ABSTRACT

The institutional goals of improving academic achievement and increasing persistence warrant consideration of the college classroom environment, with specific attention to the factors associated with actively involving students in the learning experience. This study sought to determine the effects of a cooperative learning environment on academic achievement and persistence by examining the precursory measure of student involvement. A survey was conducted of 68 freshmen from the 1992 entering class at the University of Illinois who declared a biology or biomedical major. Students exposed to the cooperative learning environment in the Undergraduate Honors Biology Workshop were compared to students exposed only to the traditional learning environment. The findings suggest that the cooperative learning environment positively influences student involvement. However, the positive influences are not carried into areas other than in the context of the cooperative learning environment. Persistence in college stemmed from the desire to obtain employment. Persistence in the major was related more towards economic gain than any particular interest in the discipline. An appendix presents internal consistency reliabilities for the Quality of Effort Scales of the College Student Experiences Questionnaire. (Contains 26 references.) (JDD)

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Involvement Through Cooperative Learning: An Attempt to Increase Persistence in the Biological Sciences

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This paper was presented at the annual meeting of the Association for the Study of Higher Education held at the Doubletree Hotel, Tucson, Arizona, November 10-13, 1994. This paper was reviewed by ASHE and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC collection of ASHE conference papers.

Abstract

The focus of this study was to determine the effects of a cooperative learning environment on academic achievement and persistence by examining the precursory measure of student involvement. The sample consisted of freshmen from the 1992 entering class at the University of Illinois who declared a biology or bio-medical major. Students exposed to the cooperative learning environment in the Undergraduate Honors Biology Workshop were compared to students exposed only to the traditional learning environment. The findings suggest that the cooperative learning environment positively influences student involvement. However, the positive influences are not carried into areas other than in the context of the cooperative learning environment. Persistence in college stemmed from the desire obtain employment. Persistence in the major was found to be related more towards economic gain than any particular interest in the discipline.

Involvement Through Cooperative Learning:
An Attempt to Increase Persistence in the Biological Sciences

Perhaps the most striking and pervasive change affecting the masses today is the fundamental shift toward a global economy. The economic shift mandates that the only way we as a nation can maintain a foothold in the economy is: to keep new ideas flowing through research; to have the best technically trained, inventive and adaptable work force of any nation; and to have citizenry able to make intellectual judgments about technically-based issues (NSB, 1986). In order to accomplish this task, it is vital to maintain a continuous pool of talented scientific researchers, teachers, and practitioners; however, this is more easily said than done due to several factors simultaneously compounding the labor pool inadequacies.

In the near future, the United States will have a smaller and older labor force with which to meet the ongoing intellectual and labor challenges posed by this economic shift. There are expectations for significant growth (6.7 million) in professional and managerial jobs based upon the projected needs for computer systems analysts, scientists, and health professionals (McLaughlin, 1989; Castle, 1993). Thus, the nation must rely more heavily upon labor market participants who traditionally have been under-represented in these areas earmarked for greatest growth (Castle, 1993). While African-Americans comprise approximately 12% of the United States population, data from the Bureau of Labor Statistics indicated they constituted 2.8% of all employed scientists and engineers in 1988 (NSF, 1990:28); Matthews, 1990:18). Hispanics accounted for 9% of the population and only 1.8% of the 1988 scientists and engineers (NSF, 1990:28; Matthews, 1990:20).

The problem of under-represented minorities in the sciences is serious enough to compromise the ability of the United States to develop and advance its traditional industrial base and to compete in international marketplaces (Matthews, 1990:2). Unfortunately, remediation for this labor shortage can only be administered when the

causes underlying symptomatic factors, such as declining interest and attrition in undergraduate science education, are understood. After all, undergraduate education is the crucial link to the supply of skilled labor in the United States since the degree is a necessary credential for access into technical professions.

Faced with tremendous obstacles in the form of demographic realities, labor force demands, rapid technological advancement, and international competition, higher education is charged with the formidable task of skill development in order to meet the nation's human resource needs (Castle, 1993:24). The action plan can be stated quite succinctly: institutions must enroll and graduate minority students in the sciences, in addition to maintaining the stream of non-minority science graduates. Revising recruiting practices can address enrollment patterns; however, graduating more students in the sciences, with emphasis on minorities, poses a much more difficult problem. This is where the wealth of college student attrition research plays a contributing role. Much of the attrition research focuses in on student involvement in the educational experience.

- **Involvement Theory**

Involvement theory emerged from the vast amount of research addressing attrition in higher education. Its evolution can be traced from earlier work in studies on retention of college students. Spady (1971) and Tinto (1975) are credited with first developing comprehensive theoretical frameworks for studying retention from which involvement theory has evolved. These frameworks are based upon the assumption that the likelihood of a student persisting to graduation is affected by the academic and social environments within the educational climate and the student's satisfaction concerning both realms. Involvement theory is rooted in the premise that the more ways colleges involve students in the academic and social environments of an institution, the more likely they are to persist to graduation (Tinto, 1975).

Involvement theory maintains that the school's role is to provide opportunities for learning and experiences that will elicit effort from students, but that the students are ultimately responsible for the amount of learning that takes place (Astin, 1984). By providing opportunities for students to become involved, institutions encourage students to devote more of their time and energy to the educational experience.

The theory of student involvement has important implications for classroom teaching. According to the theory of student involvement, if a particular curriculum is to have its intended effects, it must elicit enough student effort and investment of energy to bring about the desired learning and development (Astin, 1984:141). The extent to which students are able to develop their talents in college is a direct function of the amount of time and effort they devote to activities designed to produce these gains (Astin, 1984:143). There are opportunities for institutions to intervene and encourage student involvement. The classroom learning environment presents itself as an ideal opportunity for institutions to cultivate student involvement.

There has been a surprisingly small amount of research conducted on college classroom environments. In contrast, there has been a great deal of investigation of classroom environments at the elementary and secondary levels. Classroom environment studies at the elementary and secondary levels have shown that student perceptions account for appreciable amounts of variance in learning outcomes, often beyond that attributable to background characteristics (Fraser, 1994). Meta-analyses synthesized by Fraser, Walberg, Welch, and Hattie (1987) provide evidence that supports the link between classroom environments and student outcomes.

The implication of this research is that outcomes, like academic achievement, might be improved by creating classroom environments found empirically to be conducive to involving students in the learning process (Fraser, 1994). Furthermore, it has been noted that students are more likely to persist in college if they are satisfied with the learning experience (Noel, 1985). Obviously, involvement in the experience is the

rudiment toward achieving student satisfaction with the learning process. Thus, it seems apparent that the institutional goals of improving academic achievement and increasing persistence warrant consideration of the college classroom environment, with specific attention being paid to the factors associated with actively involving students in the learning experience.

- **Cooperative Learning**

If our goal is to involve students in an academic and social framework in order to increase the likelihood of their persistence and scholarship, it seems apparent that one possibility is to structure cooperative environments within the college classroom. This ideology is, perhaps, in direct contrast to our traditional educational pedagogy within the context of higher education which favors the competitive approach as seen, for example, in grading on a curve. However, the challenge of graduating more students in the sciences mandates a re-examination of current educational practices.

Simply placing individuals in groups with instructions to work together does not in and of itself promote higher achievement and greater socialization. As research suggests, the amount of time spent explaining and discussing correlates highly with the amount learned (Webb, 1985). The possibility then exists that abler members learn a great deal while less able members flounder as a captive audience (Johnson, Johnson, and Smith, 1991:15)

Thus, it is under only certain conditions that cooperative efforts can be expected to be more productive than competitive efforts. These five conditions have been identified by Johnson, Johnson, and Smith (1991):

1. *Positive Interdependence* - individuals encourage and facilitate each other's efforts to achieve, complete tasks, and produce to reach the group's goals.
2. *Face-to-Face Promotive Interaction* - direct interaction among students, promoted by positive interdependence, is what actually determines educational outcomes.
3. *Individual Accountability and Personal Responsibility* - individual accountability exists when the performance of each student is assessed, the results are given back

to the individual and the group, and the student is held responsible by other members of the group for contributing a fair share to the group's success.

4. *Social Skills* - students must be taught the social skills required for high-quality collaboration and to be motivated to use them if cooperative groups are to be productive.

5. *Group Processing* - reflecting on a group session to describe what actions were helpful and to decide what actions to continue or change.

If these five conditions are present, various types of outcomes have been found to be associated with cooperative learning. These outcomes include involvement indicators like achievement and socialization.

Most of the research on cooperative learning has been conducted at the elementary and secondary levels, indicating a need for further investigation at the post-secondary level. In a synthesis of studies of the achievement effects of cooperative learning in K-12 settings, Slavin (1983, 1991) found that cooperative learning methods were more effective than control methods only when group rewards were provided based on group members' achievement. Additionally, cooperative learning methods were superior to alternatives only when there was individual accountability. No study in which group members worked together to produce a single group product found positive effects (Slavin, 1983).

Slavin (1983) concluded that the effects of cooperative learning on achievement are primarily motivational, whereby the working cooperatively to achieve a group goal creates peer support which increases student motivation to assist one another (Fraser, 1994). In fact, one of the earliest and strongest findings to emerge from the research was that people who cooperate learn to like one another (Slavin, 1977). Not surprisingly, the cooperative learning classroom studies have found quite consistently that students express greater liking for their classmates as a result of participating in a cooperative learning method (Slavin, 1983, 1990).

In addition to affecting factors such as peer support for achievement and liking of classmates, additional research supports the positive impact of cooperative learning strategies on other non-cognitive outcomes such as self-esteem, and time-on-task (Johnson, Johnson, Johnson, Holubec and Roy, 1986). Therefore, examining cooperative learning from the perspective of its influences on both cognitive and non-cognitive outcomes does reveal its advantages in involving students in the educational process. It is the intent of this study to query the processes of involvement, while specifically focusing on a cooperative learning approach, with respect to students engaged in an undergraduate biology curriculum.

- **Undergraduate Honors Biology Workshop**

At the University of Illinois at Chicago, one manifestation of facilitating involvement is the Undergraduate Honors Biology Workshop Program. The goal of the Workshop is to provide students with a cooperative learning environment in biology in hopes of increasing their success and enjoyment in the subject as well as providing a fellow student support network to aid them in other biology and non-biology courses. The Workshop consists of an additional three hours beyond the required three hours of lecture, one hour of discussion, and two hours of laboratory time. These sections are taught by a teaching assistant, and have fewer students (~20) than the regular discussion sections (~30).

The students spend a large portion of the Workshop time working in groups on problem sets covering material presented in the lectures. In order to facilitate interaction among all students in the Workshop, the teaching assistants regularly assign students to different groups. Working group size vary from two to six students per group.

- **Conceptual Framework**

The institutional effort of the Undergraduate Honors Biology Workshop is an attempt at enhancing student involvement for purposes of increasing achievement and

persistence in biology. The assumption being made in the conceptual framework is that the cooperative learning environment influences student involvement which, in turn, influences academic achievement and persistence.

The question is whether the cooperative learning environment in the Undergraduate Honors Biology Workshop influenced student involvement differentially in comparison to the traditional learning environment. Did the two groups of students experience different levels of involvement, achievement, or persistence? Did the effects of the cooperative learning experience in biology spill-over to other courses and aspects of the university experience?

Research Procedures

- **Sources of Data**

The construct of involvement is operationalized through utilization of the Quality of Effort Scales in the College Student Experiences Questionnaire (CSEQ). The CSEQ measures a total of fourteen Quality of Effort scales. The underlying dimension of quality in each of the scales is reflected in a hierarchical level of activity defining student involvement. Student responses to each activity within a scale are measured on a Likert scale with 1 indicating "never" and 5 indicating "very often". Studies conducted on the psychometric properties of the fourteen scales from 20,513 undergraduates at sixty-three colleges and universities yielded internal consistency reliabilities ranging from .83 to .96 (Pace, 1990; Pace and Swayze, 1992).

Two composite scales have been created to examine the concept of involvement relative to academic and social perspectives (see Appendix A for internal consistency reliabilities). Academic involvement was operationalized based on four Quality of Effort scales: Library Experiences, Course Learning, Experience in Writing, and Science Activities. Social Involvement took into account three Quality of Effort scales: Personal Experiences, Student Acquaintances, and Experiences with Faculty.

The CSEQ was mailed to the forty-seven Workshop students and sixty-seven Control group members within the first few weeks of their Sophomore year. Thirty-eight Workshop students and thirty Control members returned the survey for a response rate of 81% and 45% respectively and 60% collectively.

Interview subjects were selected on the basis of the two composite Quality of Effort scales. Two groups were identified from minority and non-minority populations: students above one standard deviation on both scales (High Involvement); and students below one standard deviation on both scales (Low Involvement). These two groups were further identified as Workshop participants or Control Group members.

Institutional records were utilized to provide three grade point averages: biology, allied field (chemistry, physics, and math), and cumulative, as well as enrollment status in terms of two measures: persistence in the major and at UIC.

- **Analyses**

Independent t-tests were used to determine if the Workshop participants differed from the Control Group members on the Quality of Effort scales and the three measures of academic achievement. The approach taken for the analysis of the interview data was that recommended by Miles and Huberman (1994). After transcribing the recorded interviews, codes were assigned to the text to identify themes or constructs for purposes of integrating the data into an explanatory framework.

- **Results**

Academic Development

The results of the analyses indicated that the overall academic experiences and achievements of the Workshop students were similar to the Control Group students. There was no statistical difference between the two cohorts on the Quality of Effort scales dealing with academic development (Library Experiences; Course Learning; Experience in Writing; and Science Activities), or the composite construct of Academic Involvement using the same scales. There were no statistical differences between the

two cohorts in the allied field grade point average; the cumulative grade point average; persistence at the institution; and persistence in the major. The only exception was that Workshop students achieved a higher grade point average in biology than the Control Group students.

The difference in study habits between the Workshop and Control Group students became apparent in the interviews. In general, all four Control Group students preferred individual study, and believed that contributions made by groups were not as significant as the award of the individual grade. In contrast, the four Workshop students preferred group study; however, they stressed the importance of all group members actively contributing to the discussion. The Workshop students had little tolerance for lack of preparation as witnessed by the statement, "Some people come unprepared and soak information from you."

It was obvious that the Control Group students had a completely different experience in biology than the Workshop students. This fact is evidenced through the lower biology grade point average and their perceptions that there was no differentiation between biology and other courses. Contrary to the Control Group biology experiences, the Workshop students spoke of the cooperative learning environment meeting more of their needs and expectations, while helping them to adapt and become involved on the basis of their own self-motivation. The Honors Biology Workshop, by virtue of its title, made the students feel like they were members of a select group. This selective grouping also encouraged student-to-student bonding in both "High and Low Involvement" students.

The Workshop incorporated many of the active learning strategies recommended by researchers to improve instruction and enhance achievement including: visuals, student debates, discussion, and games. The Workshop students stated that "learning was fun." The Workshop students described their specific academic assignments such as: summarizing lecture/discussion notes for individual and group distribution,

completing worksheets, preparing individual and cooperative group reports, and partaking in debates, games, quizzes and discussion sessions.

The students described the T.A. in the following terms: "she was one of those funky, happy, really cool environmentalist types", "she worked with the lecture profs and brought us important information", "every lecture we ever had, she was there", and "she kept us on track". Without exception, the four Workshop students described the T.A. as a committed and involved individual who was "really good". The active involvement of the T.A. was viewed as another indicator that participation in Honors Biology was indeed a "special advantage". No other T.A. the students' had at the university was observed to perform her/his duties as the T.A. assigned to the Honors section. All the responses suggest the T.A. successfully employed both "charismatic" and "organizational" skills, thus producing a conducive learning environment by "motivating students to participate in groups".

Social Development

There were no significant statistical differences in social development between the Workshop and Control Group students as measured by the Quality of Effort scales (Personal Experiences, Student Acquaintances: and Experiences with Faculty) and the composite construct of Social Involvement using the same scales. However, differences were apparent in the social experiences based upon their interviews.

All Workshop and Control Group "High Involvement" perceived a maturation and level of comfort in the socialization process. The Workshop "Low Involvement" students commented on how the biology group interaction "forced them to make friends". All Workshop members made mention of the fact that the biology cooperative learning experience was instrumental in their achievement of a positive socialization experience.

The Workshop and Control Group students all expressed a fondness for the personalized approach. Examples of students' preferences can be seen in the following

statements: "I like first names"; "I like the personable approach used by instructors"; "Profs in small classes may get to know your name".

Persistence

Perhaps the most important finding to emerge from the persistence data is the level at which the students focus on their future career opportunities. Dropping out of college does not even appear to be an issue for either the Workshop or Control students. Perhaps this finding is a result of the sample of students. All students in the study were academic high achievers exerting comparable amounts of effort in their educational experience. Regardless of the learning environment, Workshop and Control students alike made conscious efforts to become involved in their educational experience which undoubtedly influenced persistence decisions. The statement, "I never thought of not finishing", typifies the students' responses.

It appears that this commitment to persist is based upon practicalities seen in the statements, "I'm concerned about a job after graduation"; and "I'm concerned about making money." Persistence in biology appears to be connected to career opportunities. When a Control Group student observed how much effort she had to exert to excel in her major, she briefly considered switching to history. Her decision to persist in biology was based upon her desires for the future. "I weigh the factors of money, job and comfort." Her perspective was common throughout all the students.

The responses given by the students in both cohorts suggests that persistence in higher education is not at issue because of concerns of future employment and marketability. Persistence in the major seems to be influenced to a greater extent by the perception of lucrative economic benefits rather than any particular fondness for the discipline.

Discussion

The outcome of this study supports the hypothesis that cooperative learning is a potentially valuable teaching strategy which serves to involve students in their educational experience. The students who were exposed to the cooperative learning environment achieved a higher level of academic and social integration, albeit limited to within the context of the Undergraduate Honors Biology Workshop. The group study tactics which required students to clarify, evaluate, elaborate, and argue with one another enhanced socialization as well as academic achievement. The major limitation of the cooperative learning environment was that there was limited carryover into aspects beyond the Undergraduate Honors Biology Workshop.

Although some of the socialization skills adopted by the Workshop students were present in their interactions beyond the biology experience, the academic skills of group learning failed to carryover. The Workshop students tried, although unsuccessfully, to establish a cooperative learning environment in math. This attempt suggests that there is an opportunity for carryover of cooperative learning strategies into other courses. However, it seems apparent that without the support of faculty in attaining the goal of creating a cooperative learning environment, the students do not have enough of a foundation required to successfully achieve one on their own.

The outcome of this study tends to reaffirm Tobin, Tippins, and Gallard's (1994:81) assertion that among the factors that determine whether cooperative learning is likely to be successful are the goals of the students, the extent to which students are motivated to learn and cooperate, and the degree to which the teacher believes cooperative learning to be a viable activity for the class.

It is interesting to note that the experiences of the students were similar based upon their "High and Low Involvement" status or their exposure to the cooperative learning environment. Gender or minority/non-minority status did not seem to impart any affects which influenced student involvement in academic or social

contexts. The lack of gender or ethnic influence on involvement suggests that perhaps educators need to focus on student needs which are not readily recognized by demographic characteristics. The implication of this finding is that the goal of enhancing student involvement is all the more challenging because students must be dealt with as individuals.

The Undergraduate Honors Biology Workshop incorporated many of the suggestions made by researchers to improve instruction, enhance achievement, and develop social skills of students. All four Workshop students reported on the various instructional strategies used in both the traditional lectures and the non-traditional discussion groups in biology. The students spoke of how the cooperative learning environment changed their academic and social skills in biology. Both "High and Low Involvement" students explained "learning was fun", "we argued, we debated, everyone benefited". "The best way to study is with groups of people... with visuals, such as boards, 3-D diagrams."

Conclusions

This study presents evidence to support the contention that cooperative learning environments involve students in their academic and social experiences. However, no generalizations can be made since the study was limited to one institutional department's efforts at one period in time.

Additional considerations on this particular study relate to the question involving the Hawthorne Effect (Dickson and Roethlisberger, 1966). Were the academic and social skills impacted in part because the students knew they were part of an experimental program? Did the students make greater efforts because they were being monitored? The students referred to the "honors" title, additional credit hours awarded, and the variety of innovative cooperative strategies they experienced. All of these factors may have affected their outcomes. Another area of inquiry would be

investigating if the increased time-on-task influence social skills and academic achievement?

Cooperative learning has become an important strand of research on science teaching during the past decade and continues to be of interest to science educators (Tobin, 1990). There is, however, remarkably little empirical research on the teacher's mediational role in cooperative learning environments or how cooperative learning actually develops. Tobin (1990) points out that although studies of cooperative learning in the context of science abound, the focus of these studies has not been on the learning process. The learning process seems to be a highly complex network of associations influenced in part by the teacher's presentation and demeanor. It is apparent that more research needs to be conducted to obtain an understanding of the learning process within the context of cooperative learning in a higher education setting.

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APPENDIX A

Quality of Effort Scales

Library Experiences (alpha = .83)
Used the library as a quiet place to read or study materials brought with you.
Used the card catalogue to find what materials there were on some topic.
Asked the librarian for help in finding material on some topic.
Read something in the reserve book room or reference section.
Used indexes (such as the Reader's Guide to Periodical Literature) to journal articles.
Developed a bibliography or set of references for use in a term paper or other report.
Found some interesting material to read just by browsing in the stacks.
Ran down leads, looked for further references that were cited in things you read.
Gone back to read a basic reference or document that other authors had often referred to.

Experiences with Faculty (alpha = .90)
Talked with a faculty member.
Asked your instructor for information related to a course you were taking.
Visited informally and briefly with an instructor after class.
Made an appointment to meet with a faculty member in his/her office.
Discussed ideas for a term paper or other class project with a faculty member.
Asked your instructor for comments and criticisms about your work.
Discussed your career plans and ambitions with a faculty member.
Had coffee, coke, or snacks with a faculty member.
Worked with a faculty member on a research project.
Discussed personal problems or concerns with a faculty member.

Course Learning (alpha = .96)
Took detailed notes in class
Underlined major points in the readings.
Tried to see how different facts and ideas fit together.
Thought about practical applications of the material.
Worked on a paper or project where you had to integrate ideas from various sources.
Summarized major points and information in your readings or notes.
Tried to explain the material to another student or friend.
Made outlines from class notes or readings.
Did additional readings on topics that were introduced and discussed in class.

Experience in Writing (alpha = .85)

Used a dictionary or thesaurus to look up the proper meaning of words.
Consciously and systematically thought about grammar, sentence structure, paragraphs, word choice, and sequence of ideas or points as you were writing.
Wrote a rough draft of a paper or essay and then revised it yourself before handing it in.
Spent at least five hours or more writing a paper.
Asked other people to read something you wrote to see if it was clear to them.
Referred to a book or manual about style of writing, grammar, etc.
Revised a paper or composition two or more times before you were satisfied with it.
Asked an instructor for advice and help to improve your writing.
Made an appointment to talk with an instructor who had criticized a paper you had written.
Submitted for publication an article, story, or other composition you had written.

Personal Experiences (alpha = .96)

Told a friend why you reacted to another person the way you did.
Discussed with other students why some groups get along smoothly, and other groups don't.
Sought out a friend to help you with a personal problem.
Elected a course that dealt with understanding personal and social behavior.
Identified with a character in a book or movie and wondered what you might have done under the circumstances.
Read articles or books about personal adjustment and personality development.
Taken a test to measure your abilities, interests, or attitudes.
Asked a friend to tell you what he/she really thought about you.
Been in a group where each person, including yourself, talked about his/her personal problems.
Talked with a counselor or other specialist about problems of a personal nature.

Student Acquaintances (alpha = .96)
- Made friends with students whose academic major field was very different from yours.
- Made friends with students whose interests were very different from yours.
- Made friends with students whose family background was very different from yours.
- Made friends with students whose age was very different from yours.
- Made friends with students whose race was different from yours.
- Made friends with students from another country.
- Had serious discussions with students whose philosophy of life or personal values were very different from yours.
- Had serious discussions with students whose religious beliefs were very different from yours.
- Had serious discussions with students whose political opinions were very different from yours.
- Had serious discussions with students from a country different from yours.

Science (alpha = .91)
- Memorized formulas, definitions, technical terms.
- Tried to express a set of relationships in mathematical terms.
- Tested your understanding of some scientific principle by seeing if you could explain it to another student.
- Read articles (not assigned) about scientific theories or concepts.
- Practiced to improve your skill in using some laboratory equipment.
- Showed a classmate how to use a piece of scientific equipment.
- Attempted to explain an experimental procedure to a classmate.
- Went to an exhibit or demonstration of some new scientific device.

Academic Involvement (alpha = .67)
- Library
- Course Learning
- Experience in Writing
- Science

Social Involvement (alpha = .73)
- Personal Experiences
- Student Acquaintances
- Experiences with Faculty